## Claims

1. A prosthetic joint device for articulating segments characterized in that it comprises

- a first component (2) having a first articular bearing surface (5);
- a second component (3) having a second articular bearing surface (6) opposite to the first bearing surface (5) of the first component (2); and
- a third component (4) interposed to the first (2) and the second component (3), having two articular third and fourth bearing surfaces (7, 8) whose individual forms are substantially complementary to said first and second articular surfaces (5, 6) of the first (2) and of the second (3) components, said two third and fourth articular bearing surfaces (7, 8) being freely slidably and individually non-captively engaged;
- said first articular bearing surface (5) and said second articular bearing surface (6) being both shaped not reproducing the natural corresponding shapes of said articulating segments;
- the first and third (5, 7) and the second and fourth (6, 8) articular bearing surfaces being shaped complementarily and mutually to allow the non-fixed axis of rotation of the articulation to be reproduced while maintaining full congruence.

2. A prosthetic joint device according to claim 1, characterized in that the first and third (5, 7) and the second and fourth (6, 8) articular bearing surfaces are shaped complementarily and mutually to allow the non-fixed axis of rotation of the articulation to be reproduced based on the typical isometric rotation kinematics of some ligament fibers (9, 10) of the natural joint in the unloaded state, therefore optimally designed from the subject-specific geometry of said ligament fibers (9, 10).

3. A prosthesis joint device, as claimed in claim 1, characterized in that it comprises a first component (2) having a generally convex first articular bearing surface (5); a second component (3) having an articular bearing second surface (6) that is generally convex in a sagittal plane and partly concave in a frontal plane; and a third component (4) having two articular third and fourth bearing surfaces (7, 8) with front-to-back disposition and with individual shapes that are substantially complementary to said first and second articular surfaces (5, 6) of the first (2) and of the second (3) component, said third component (4) being situated between said first and second component (2, 3) with the two pairs of said complementary surfaces first and third (5, 7) – fourth and second (8, 6) coupled in the said freely sliding and individually unconstrained manner.

4. A prosthesis joint device as claimed in claim 1 or 3, characterized in that the first articular surface (5) of said first component (2) and the third articular surface (7) of said third component (4) complementary thereto are each shaped partly spherically with equal radii of curvature.

5. A prosthesis joint device as claimed in claim 1 or 3, characterized in that the second articular surface (6) of said second component (3) and the fourth articular surface (8) of said third component (4) complementary thereto are each partly anticlastic surface and have equal curvatures.

6. A prosthesis joint device as claimed in claim 1 or 3, characterized in that said first and second component (2, 3) present wholly metallic construction, and said third component (4) is wholly constructed of plastic material.

7. A prosthesis joint device (1) for an articulation with non congruent shape between two articular bone segments (11, 20) wherein the first bone segment (11) and the second bone segment (20) have articular surfaces respectively with

individually concave and convex curvatures with greater and lesser radii of curvatures, said device (1) being characterized in that it comprises a first component (2) having a partially spherical convex first articular bearing surface (5) suitable for being anchored to said first bone segment (11) to replace said concave surface; a second component (3) having a second articular bearing surface (6) that is convex in a sagittal plane and partly concave in a frontal plane, i.e. partly anticlastic, and suitable for being anchored to said second bone segment (20) to replace said convex surface; and a third component (4) having two articular third and fourth bearing surfaces (7, 8) in front-to-back disposition, one of said two surfaces, the third (7), presenting partially spherical concave shape with curvature equal to the convex first surface (5) of the first component (2), and the other bearing surface, the fourth (8), being a partly anticlastic surface with curvatures equal to the curvatures of the second articular bearing surface (6) of the second component (3); said third component (4) being interposed to the first (2) and the second component (3), having said two articular third and fourth bearing surfaces (7, 8) whose individual forms are substantially complementary to said first and second articular surfaces (5, 6) of the first (2) and of the second (3) components, said two third and fourth articular bearing surfaces (7, 8) being freely slidably and individually non-captively engaged.

8. A prosthesis joint device as claimed in claim 3 characterized in that each of said components (2, 3, 4) presents single-piece construction.

9. A prosthesis joint device for the human ankle articulation for an articulation of incongruent shape between two bone segments (11, 20) wherein a first (11) and a second bone segments (20) have articular surfaces respectively with individually concave and convex curvatures with greater and lesser radii of curvature, said device (1) being characterized in that it comprises a tibial component (2) able to be anchored to the tibia (11) and defining a partially spherical convex first articular

bearing surface (5); a talar component (3) able to be anchored to the talus (20) and defining a partly anticlastic second articular bearing surface (6); and a meniscal component (4) defining two articular third and fourth bearing surfaces (7, 8) in front-to-back disposition, one, the third (7), of said two surfaces presenting partially spherical concave shape with curvature equal to the convex first surface (5) of the first component (2), and the other, the fourth (8), of said two surfaces being a second partly anticlastic surface (6) with curvatures equaling those of said talar component (3); said meniscal component (4) being situated and maintained between the tibial (2) and talar (3) components, having said two articular third and fourth bearing surfaces (7, 8) whose individual forms are substantially complementary to said first and second articular surfaces (5, 6) of the tibial (2) and of the talar (3) components, said two third and fourth articular bearing surfaces (7, 8) being freely slidably and individually non-captively engaged.

10. A method for implanting a prosthesis joint device (1) for the replacement of an anatomical articulation between two bone segments (11, 20) characterized in that it comprises the following steps of measurements and cuts:

- making two opposite antero-posterior cuts (61, 62) respectively on the first (11) and on the second (20) bone segments;
- coating the second bone segment (20) with a prosthesis component (3) having a partly anticlastic articular bearing surface (6) generally convex in a sagittal plane and generally concave in a frontal plane of the articulation;
- making, on the first bone segment (11), holes (50), for the insertion of bars (12) for fastening an opposite component (2) of the prosthesis device (1), said holes (50) being obtained by means of a succession of sinking steps of a drilling device, alternating each sinking step of the drilling device, and until reaching the maximum depth of the holes (50), with measurements of the gap between a trial component (68) to be inserted in the first bone segment (11) and the second articular surface (6) of the prosthesis component (3) coating the second bone segment (20), said

measurements being suitable for ascertaining that said gap remains identical both in a position of maximum dorsi-flexion, and in a position of maximum plantar-flexion of the articulation;

- definitively implanting in the first bone segment (11) the corresponding component (2) of the prosthesis device (1);

- interposing between the components (2,3) of the prosthesis device (1) a third meniscal component (4) having two articular third and fourth bearing surfaces (7, 8) whose individual shapes are substantially complementary to the first and second articular surfaces (5, 6) of the two components (2, 3) of the prosthesis device (1) associated to said two bone segments (11, 20), said meniscal component (4) being provided with thickness suitable for reproducing the situation of correct tensioning of the ligaments (9, 10) corresponding to the natural articulation, throughout the range of motion of the articulation.

11. A method, as claimed in claim 10, characterized in that said phase of coating the second bone segment (20) includes:

- executing, on an extremity of the cut (62) made on the second bone segment (20), a first chamfer (64) having a small depth, corresponding to a first-trial value;

- inserting, into the cut (62) and into the first chamfer (64), a three-dimensional template (65) of the component (3) of the prosthesis device (1) relating to the second bone segment (20), which template (65) has identical shape to the shape of said component (3) with the exception of the related parts destined to be located in the second bone segment (20), posteriorly and inferiorly to the surface of the cut (62);

- searching, through trials of measurements and cuts, the optimal antero-posterior position for implanting the component (3) of the prosthesis device of the second bone segment (20) by executing in succession the following phases: measuring the gap between the cut (61) of the first bone segment (11) and of the template (65), in the positions of maximum dorsi flexion and maximum plantar

flexion of the articulation; removing the template (65); and increasing the depth of the chamfer (64) by removing larger and larger portions of bone; followed lastly by a new insertion in situ of the template (65); said succession of phases being repeated until obtaining the identity of the gaps interposed between the cut (61) of the first bone segment (11) and the template (65) in the dorsi-flexion and plantar-flexion positions of the articulation;

- drilling, in the second bone segment (20), holes (66) for corresponding pins (19a, 19b) for anchoring the related component (3) of the prosthesis device (1);
- executing a second chamfer (63) on the opposite posterior extremity of the anterior chamfer (64) of the second bone segment (20);
- definitively removing the template (65), definitively replacing it with the corresponding component (3) of the prosthesis device (1).

12. A method, as claimed in claim 10, characterized in that said phase of drilling, on the first bone segment (11) holes (50) for the insertion of fastening bars (12) provides for:

- employing a guide template (70) having an inferior surface (67) complementary to the shape of the articular surface (6) of the second component (3) of the prosthesis device (1) associated to the second bone segment (20), said template (70) operating in bearing on said articular surface (6);
- seeking the optimal antero-posterior position of the component (2) of the prosthesis device (1) relating to the first bone segment (11) by performing a succession of phases which include: progressively deepening the holes (50) in steps; inserting, all the way to the bottom of the holes (50) obtained, a trial component (68) corresponding to the component (2) of a prosthesis device (1) relating to the first bone segment (11); and lastly measuring the gap between the trial component (68) and the component (20) of the prosthesis device already implanted in the second bone segment (3), said gap measurement being performed in the positions respectively corresponding to the maximum dorsi-flexion and to the

maximum plantar-flexion of the articulation; said succession of phases being repeated until reaching identity between the gaps in dorsi-flexion and in plantar-flexion, in which the holes (50) have reached the exact depth to contain the cylindrical elements (12) of the component (2) of the prosthesis device (1) to be associated to the first bone segment (20);

- removing, from the first bone segment (1), the trial component (68) and definitively implanting the related component (2) of the prosthesis device (1).

13. A method, as claimed in claim 10, characterized in that said phase of interposing the third component (4) of the prosthesis device (1) comprises the trial insertion of third components (4) which have different thickness able to reproduce the situation of tensioning of the ligaments (9, 10) corresponding to the natural articulation throughout the field of motion of the articulation.

14. A method, as claimed in one of the previous claims from 10 to 13, characterized in that the measurement of the gap between the cut (61) of the first bone segment (11) and the component (3) of the prosthesis device (1) of the second bone segment (20) is performed by inserting an element (51) with calibrated thickness (54) having a planar upper surface (52) able to be associated to the cut (61) of the first bone segment (11) and a curved lower surface (53) conforming to the articulation surface (6) of the component (3) of the prosthesis device able to be associated to the second bone segment (20).

15. A method, as claimed in one of the previous claims from 10 to 14, characterized in that the measurement of the gap interposed between the components (2, 3) of the prosthesis device implanted in the bone segments (11, 20) is performed by inserting an element (55) with calibrated thickness (58) having a curved concave upper surface (56) able to be associated to the articular surface (5) of the component (2) of the prosthesis device implanted in the first bone segment

(11) and a curved lower surface (57) conforming to the articulation surface (6) of the component (3) of the prosthesis device able to be associated to the second bone segment (20).

16. A method, as claimed in one of the previous claims from 9 to 14, characterized in that said first bone segment is a distal segment of human tibia, and said second bone segment is a proximal segment of human talus.

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